R·I·T

Title: Karl Suss MA150

Semiconductor & Microsystems
Fabrication Laboratory **Revision: F** **Rev Date: 05/08/2020**

Approved by:

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Process Engineer Equipment Engineer

1 SCOPE

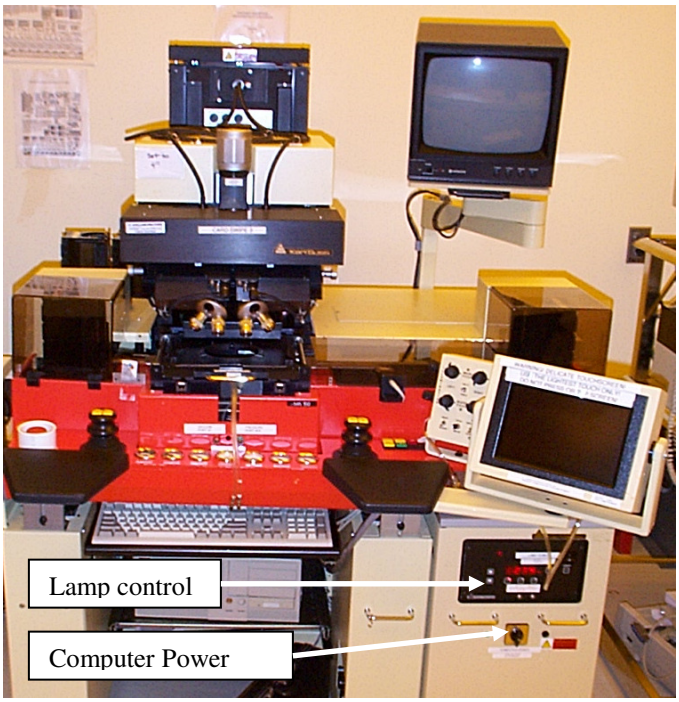
The purpose of this document is to detail the use of the Karl Suss MA150 Mask Aligner. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- Material Safety Data Sheet for the resist and developer that you are using.
- Appropriate Tool Manuals

3 DEFINITIONS

n/a



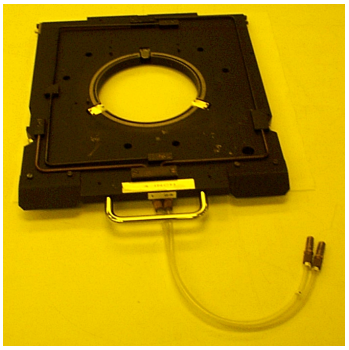
4 TOOLS AND MATERIALS

4.1 General Description - The Karl Suss MA150 may be set up to align and expose with various sized wafers and masks. The features on the mask will print the same size on the wafer so stepper masks will not work on this aligner. The aligner may use broadband or i-line for exposures.

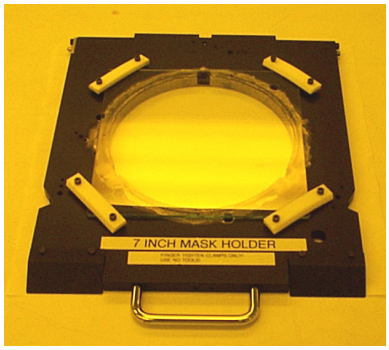
4.2 Wafer Boats – The tool is loaded manually and boats are not used.

4.3 **Mask Holders -** There are three different mask holders. See SMFL staff for training on changing aligner configuration.

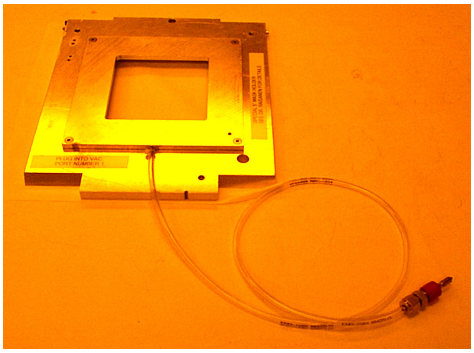
4.3.1 **Standard 5-inch mask holder** for contact and proximity modes for 4 inch wafers.



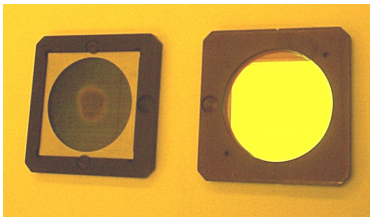
4.3.2 **Modified mask holder** for 7-inch glass, for contact mode only on 4 and 6 inch wafers.



4.3.3 **Custom holder** for 5-inch glass which holds the mask from the back, allowing 5-inch plates to be used on 6-inch wafers. (For contact mode only)



4.4 Filters - Two filters are available. A neutral-density filter which looks like a screen is used for reducing the intensity to provide greater process latitude. The other one is an i-line filter.



4.5 Wafer Chucks - A 4 inch wafer chuck and a 6 inch wafer chuck are available. See SMFL staff to change a chuck.

5 SAFETY PRECAUTIONS

5.1 Personal Safety Hazards

5.1.1 **UV Light** - The aligner has a mercury arc ultraviolet light source. Do not look into the direct light area without wearing special UV light protection.

5.1.2 **Moving Parts** - Keep all body parts and objects out of the path of moving parts on the mask aligner. Do not operate with guards out of place or try to bypass interlocks.

5.1.3 **Sharps** - Broken pieces of silicon wafers very sharp and slivers may puncture or cut the skin.

5.2 Hazards to the Tool

5.2.1 **Solvents** - Do not clean the aligner with acetone. IPA/De-ionized water solutions are acceptable to use.
5.2.2 **Contamination** - Wafers need to be clean and kept free of contamination as much as possible. It is a good idea to inspect the backs of the wafers as well as the mask for any resist that could gum up the system.
5.2.5 **Fixture Size** - Make sure that the aligner is set up with the appropriate wafer chuck and mask holder.
5.2.6 **Computer** - The computer should be **off** when the lamp is being turned on or off.
5.2.7 **Lenses** - Never remove any lenses or filters except the optional ones.

6 INSTRUCTIONS

6.1 Initial State Check

6.1.1 In the service chase, verify that the nitrogen and the compressed air are on.
6.1.2 The lamp is usually left on. If it is not on, turn on the **Lamp Power**. The display will cycle through self-testing.
6.1.3 Wait for **rdy** to be displayed.
6.1.4 Press the **START** button under the **Lamp Power Switch**. Unit will make an arcing noise as the lamp starts. The lamp must warm up before continuing or using.
6.1.5 COLD will flash on the display until the mercury lamp is warmed up, about 20 minutes.
6.1.6 Turn the **COMPUTER POWER** on to the MA-150 via the electric disconnect switch on the right lower front panel. This should be done *after* powering up the Lamp Power.
6.1.7 The monitor is usually left on. If it is off, turn it on with the rocker switch on the back of the monitor.
6.1.8 Wait for the machine to initialize. Initialization sequence will be displayed on the touch screen display located at the right front on the unit.
6.1.9 Login to by touching **LOGIN** on the touch screen. The username and password are both **xerox**.
6.1.10 Verify that your mask and substrates are clean. Dirty masks may be cleaned with acetone.
6.1.11 Verify that the system is set up for the correct wafer size, with the correct mask holder and the correct wafer chuck. See an SMFL staff member for assistance. Do not make any changes if you have not been properly trained.
6.1.12 Verify which filter is in the housing and remove it if not needed.

6.2 **Check Intensity -** Remove the mask holder and place the probe on the chuck. Make sure that you are wearing UV protective eyewear. Press **System** on the touch screen and then **Light Measure** to open the shutter. Press **Return** when done.

6.3 **Load Program -** Touch the **CHANGE PRGR** button and then the **LIST** button. Highlight the appropriate program listed by touching **CURSOR UP** or **CURSOR DOWN** button, touch the **LOAD** button and then touch the **RETURN** button.

6.3.1 **Modifying a Program** - Note that the system is typically used in hard contact mode. Proximity contact can only be used with 5-inch plates and 4-inch wafers. Vacuum contact is not available, even though it shows it as an option in the menus.

6.3.2 **Exposure Time** - Exposures of up to 99.9 seconds can be performed with a recipe. Longer exposures must be run manually by commanding the shutter to open and timing the exposure with a stopwatch.

6.3 Reset the microscope/mask stage - To get the best range of travel, go to the **System Menu** and choose **Reset Mic/Mask Stage**. The stage will reset. Select **Cancel** when finished.

6.5 **Load Wafer** – Place wafer on the chuck; use care to center it and align the flat.

6.6 **Load Mask Holder**

6.6.1 **Standard Mask Holder** - Position the mask against the three locator pins, chrome side down. Touch the **VACUUM** button to toggle **ON** vacuum to the mask. Push the mask platform in towards the machine and touch the **CLAMPING OFF** button to engage the clamp to the mask chuck. It will toggle **ON.** Touch **RETURN** to return to the main screen.

6.6.2 **Modified Mask Holder** – Use care not to over tighten the screws holding the mask or the mask could bow, leading to a poor image. The mask vacuum must be toggled to trick the tool, even though vacuum is not used.

6.6.3 **Custom Mask Holder** – This holder uses the large plug in port for vacuum. Make sure to check that it has vacuum so that it does not fall when it is flipped over.

6.7 Start - Press the green START/STOP button twice to raise wafer to the alignment position.

6.8 Alignment and Exposure

6.8.1 When aligning a wafer, first adjust the microscope so that it is centered over the alignment marks on the wafer. Next, adjust the mask so that it is aligned to the wafer.
6.8.2 Begin by toggling the enhanced/normal switch to **NORMAL** and the mask/wafer switch to **WAFER.**
6.8.3 Adjust the wafer illumination by turning the **ILLUMINATION** knob on left side of **Image Controller**.
6.8.4 Adjust wafer focus by turning wafer **FOCUS** knobs (left and right).
6.8.5 Press **MICROSC** button (top left joystick) to enable microscope stage movement.
6.8.6 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) find the alignment fiducials on the wafer. It may also be necessary to move the microscope objectives.
6.8.7 Press **MICROSC** button to disable microscope control (the red LED will turn off).
6.8.8 Press **MASK** button (top of left joystick) to enable mask control.
6.8.9 Adjust mask and wafer focus by turning **WAFER FOCUS** knobs.
6.8.10 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) find the alignment fiducials on the mask.
6.8.11 By pressing both the **MASK** and **MICROSC** buttons, the mask and microscope will move at the same time so that the wafer appears to move under a stationary mask.
6.8.12 Once alignment is acceptable, press **CONT. SEP**. button (top of the right joystick). The wafer will come to the exposure position and the **EXPOSURE** button will light on the control panel.
6.8.13 If alignment still looks acceptable, press the **EXPOSURE** button.
6.8.14 The microscope assembly will rotate upward and the lamp shutter will move over the mask/substrate. The wafer will expose for the predetermined time after which the lamp shutter will retract.
6.8.15 Some very thick resists may require the use of the Frame Grabbing Feature for alignment. See the appendix for instructions.

6.9 **Removing the Mask -** Touch the **Mask** button, the **Vacuum** button and the **Clamp** button.

6.10 Remove the wafer from the chuck.

6.11 Short Program

6.11.1 Load the desired program.
6.11.2 Remove the mask holder and place the substrate on the wafer chuck.
6.11.3 Replace the mask holder and install the mask.
6.11.4 On the **Main Menu**, press the **System** button.
6.11.5 Press the **Short Program** button. You will get the following message **Watch out for Wafer Transport. Touch to Continue.** Touch to continue and use caution as transport arms will move.
6.11.6 Press **Mask** and turn **Vacuum ON** and **Clamping ON**. Press **Return**.
6.11.7 Press the green **Start/Stop** button (not on the screen) and the chuck will either come up for exposure or alignment, depending on the recipe.
6.11.8 If alignment is required, proceed as before.
6.11.9 Press the red **Reset** button twice. Wait for the handling to stop before retrieving wafer.
6.11.10 When finished remove the mask, mask-holder and substrate.

6.12 Errors during Run

6.12.1 Occasionally the touch screen will lock up. If this happens, turn the System Power switch off. Wait 20 seconds and then turn it back on. The system will take several minutes to reboot.

6.13 **Resetting the System**

6.13.1 Remove wafer from the system.
6.13.2 Make sure all covers are closed and all safety shields are in place.
6.13.3 Press the **Reset** button.

7 APPROPRIATE USES OF THE TOOL

7.1 Use caution when doing a hard contact exposure because the wafer may stick to the mask.
7.2 Only substrates with clean backs may be processed.

8 ATTACHMENTS

8.1 Use of Frame Grabbing Feature on Karl Suss MA-150

8.2.1 Toggle enhanced/normal switch to **NORMAL.**
8.2.2 Toggle mask/wafer switch to **WAFER.**
8.2.3 Adjust wafer illumination by turning **ILLUMINATION** knob.
8.2.4 Adjust wafer focus by turning wafer **FOCUS** knobs (left and right).
8.2.5 Press **MICROS** button (top left joystick) to enable microscope stage movement.

8.2.6 By using the right joystick (X, Y movement controller) and the left joystick, (theta rotation controller) find the alignment fiducials on the wafer.
8.2.7 Press **MICROSC** button to disable microscope control.
8.2.8 Press **MASK** button (top of left joystick) to enable mask control.
8.2.9 Adjust mask focus by turning **MASK FOCUS** knobs.
8.2.10 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) find the alignment fiducials on the mask.
8.2.11 Move the mask fiducials to the right until they do not appear on the monitor screen.
8.2.12 Toggle enhanced/normal switch top **ENHANCED.**
8.2.13 Press the **GRAB IMAGE** button.
8.2.14 Move the mask fiducials to the left so they appear on the monitor.
8.2.15 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) align the mask fiducials to the wafer fiducials.
8.2.16 Once alignment is acceptable, press **CONT. SEP**. button (top of the right joystick). The **EXPOSURE** button will light.
8.2.17 If alignment still looks acceptable, press **EXPOSURE** button. The microscope assembly will rotate upward and the lamp shutter will move over the mask/substrate. The lamp will expose for predetermined time after which the lamp shutter retracts.
8.2.18 If alignment does not look acceptable, press **CONT. SEP**. button and adjust alignment of wafer to mask.
8.2.19 Press **CONT. SEP**. when alignment is acceptable. Repeat step until alignment is acceptable and wafer is exposed.
8.2.20 Repeat steps for additional wafers if use of frame grabber is necessary, if frame grabbing is not needed, use normal operation

REVISION RECORD

Summary of Changes	**Originator**	**Rev/Date**
Original Issue	Sean O'Brien	A-12/16/2002
4.1.1 removed vac. contact, added 5.2.4, 5.2.5, 5.2.6, 6.1.11, 7.2, 7.3	Sean O'Brien	B- 01/23/2003
Added 6.4, 5.2.7, 6.3.5.11, 6.3.5.15, removed 6.3.11, 6.3.12, other sections were clarified.	Sean O'Brien	C- 06/03/2004
Added information on mask holders , 6.1.12, 6.1.13, 6.3.3.1, 6.3.3.2	Sean O'Brien	D-11/10/2004
Added procedure for resetting the stage, clarified 6.4	Sean O'Brien	E- 03/01/2006
Removed references to wafer handling, improved format	Meller/O'Brien	F-05/08/2020